

The Sustainability Problems of Irrigation in Turkey

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Abstract: Water, a vital source for humanity and all living things throughout the history, has contributed to the formation of civilizations. It has the economical value as well as social and cultural characteristics. The land and water potentials have reduced due to rapid growing in urbanization and industrialization in Turkey. Water quality has begun to deteriorate as a result of environmental factors. Irrigated land also has been increasing every year. Turkey has arid and semi-arid climate characteristics and annual average precipitation is almost 643 mm. The total annual available surface and groundwater potential is 110 km³. Annual water potential per capita is 2565 m³, and available water potential is 1517 m³ in Turkey. According to the water per capita, Turkey is a water-stress country. Turkey covers a total land area of 78 million hectares, of which 28 million hectares is cultivated land. The economically irrigable land is 8.5 million hectares under the present condition. According to the 2009 records, irrigated land is 5.1 million hectares. Presence of large number of fragmented and small farm lands, scant water supplies, poor and insufficient infrastructures in irrigation networks, deficiency in irrigation water management and drainage problems have affected negatively to the sustainability of irrigation in Turkey.

Keywords: Water, land and water potentials, available water potential, sustainable irrigation.

Introduction

Water is the prime element for human life on earth but, it is not exist in every place, amount and time on earth. It is the strategic natural resource and will be also very important. The utilization of water resources and related studies are as old as human history. In general, agriculture is the most water user sector in the world.

The increase of the population has resulted more water requirement. There is a serious water scarcity and water stress problems in 80 countries with 40% of population. It is estimated that the world population will reach about to the 8.5 billion in the year of 2025. This shows that population will increase as 35-40% between current and 2025 year. Food problems associated by irrigation will be very serious in future. In present, water scarcity problems have been observed mainly in African and Middle East Countries as well as highly populated Asian Countries (Çiftçi et al 2009a; Çiftçi et al. 2009b).

Water resources are 1.36 billion km³ in the world. Of this amount, 97 % is saline water with only 35 million km³ of this is fresh water (3%). The 68.3% of this is in poles as a freeze form and 31.4% of is as soil moisture or groundwater form. The 0.3% of total fresh water in the world is streams, lakes and swamps areas (Çiftçi & Kutlar 2007).

Presence of non-uniform water distribution in world causes some problems. The reason of it water distribution is difference in hydrological cycle in different places.

The development level of countries has very important role in water consumption. As we mentioned above in most countries, agriculture is the highest water user. Water is used for three different purposes. These are; - drinking and usage (in residents) - agriculture, and 3- industry . The averages of water use in the world are 70%, 20% and 10% in agriculture, industry and drinking and usage, respectively.

Increase in water use has lead to reduction in water quality. Human activities may cause two type of contamination of water resources. It is very important for human health, especially for children, to use the fresh water at present. In the world, almost one million people in 40 countries have used the poor quality water. Increment in irrigated lands will also increase the water consumption.

Turkey is situated in 36°-42° North latitude and 26°-45° East longitude so that it has a unique geographical and cultural position. The length of the land border is 2949 km and coastal boundary of 7816 km with total of 10765 km. The neighbors are Greece and Bulgaria in West; Georgia, Armenia, Azerbaijan, Iran in East and ; Iraq, Syria in South. Ankara, capital city of Turkey, is 875 m above the sea level (Ulus) (Anonymous 2009).

The construction of huge irrigation networks started after 1950's and had very importance. These big irrigation projects are irrigated by Menderes, Gediz, Seyhan, Ceyhan, Yeşilırmak, Kızılırmak, Fırat and Dicle Rivers. The project consisted of Dicle and Fırat is called as Southeastern Anatolian Project (SAP) and is one of the huge projects in the world (Kara 2005).

Turkey can be considered a ' water-stressed 'country according to the water resources. It is estimated that available water potential of Turkey will be fully used after 20 years.

Land and Water Potential in Turkey

Land Potential of Turkey

Agricultural production is the function of arable land and soil fertility in such area. It means that not only land size is important but also fertility of soil is very important. Turkey covers 28 million hectares of cultivated land.

To make an irrigation project, arable land and water supply as well as suitability of arable land for irrigation are necessary. The land potential with the slope lower than 6% is 16.5 million hectares in Turkey. The 8.5% of this is economically irrigable land. The irrigated land at present is 5.1 million ha (Çiftçi et al. 2008) are presented in Table 1 (Kara 2005, Çiftçi & Kutlar 2007).

Land Status		Area (million ha)
1.	Arable land	26.6
2.	Land for field crop production	16.0
3.	Land for vineyard and Horticulture	2.6
4.	Land for meadow	8.0
• Irrigable Land		16.5
• Economically irrigable land		8.5
• Land suitable for irrigation after the some improvement		8.0
• Currently irrigated land		5.1

Table 1. The utilization patterns of lands in Turkey

As seen from the Table 1 that almost 8 million ha land is exposed to fallow. As a result of this, although arable land potential is 26.6 ha, only 18.6 ha of it is under cultivation.

Water Potential of Turkey

In general, the climate is semi-arid in Turkey. Due to the surrounding with three directions of Turkey by seas, high mountains lies on parallel to the sea costs, rapid changes in elevation and distance to the coasts result in climate changes in small distances. Turkey has different climate characteristics due to the geographical position. In the exception of the East Black Region, the climate varies from arid to semi-arid. The climate changes depend upon the seasons and regional differences. There are total 26 big river basins in Turkey. There is difference between the basins in respect to the rainfall. The annual rainfalls are 350mm and 2400mm for Middle Anatolia Region and East Black Sea, respectively.

Water potential of a country is the sum of surface and groundwater. As it is known that source of the water in earth is rainfall.

The annual average precipitation in Turkey is almost 643 mm, corresponding to a volume of 501 km³ and the annual runoff is 186 km³. The 274 km³ of total precipitation is lost by transpiration and evaporation. Another 41 km³ of total precipitation feeds the underground water system and 186 km³ end up as surface runoff. The annual consumable surface water potential is computed as 98 km³ and extractable groundwater potential of 12 km³ should be added to this, bringing the total annual consumable potential to 110 km³ (Figure 1) (Kara 2005; Çiftçi et al. 2009b).

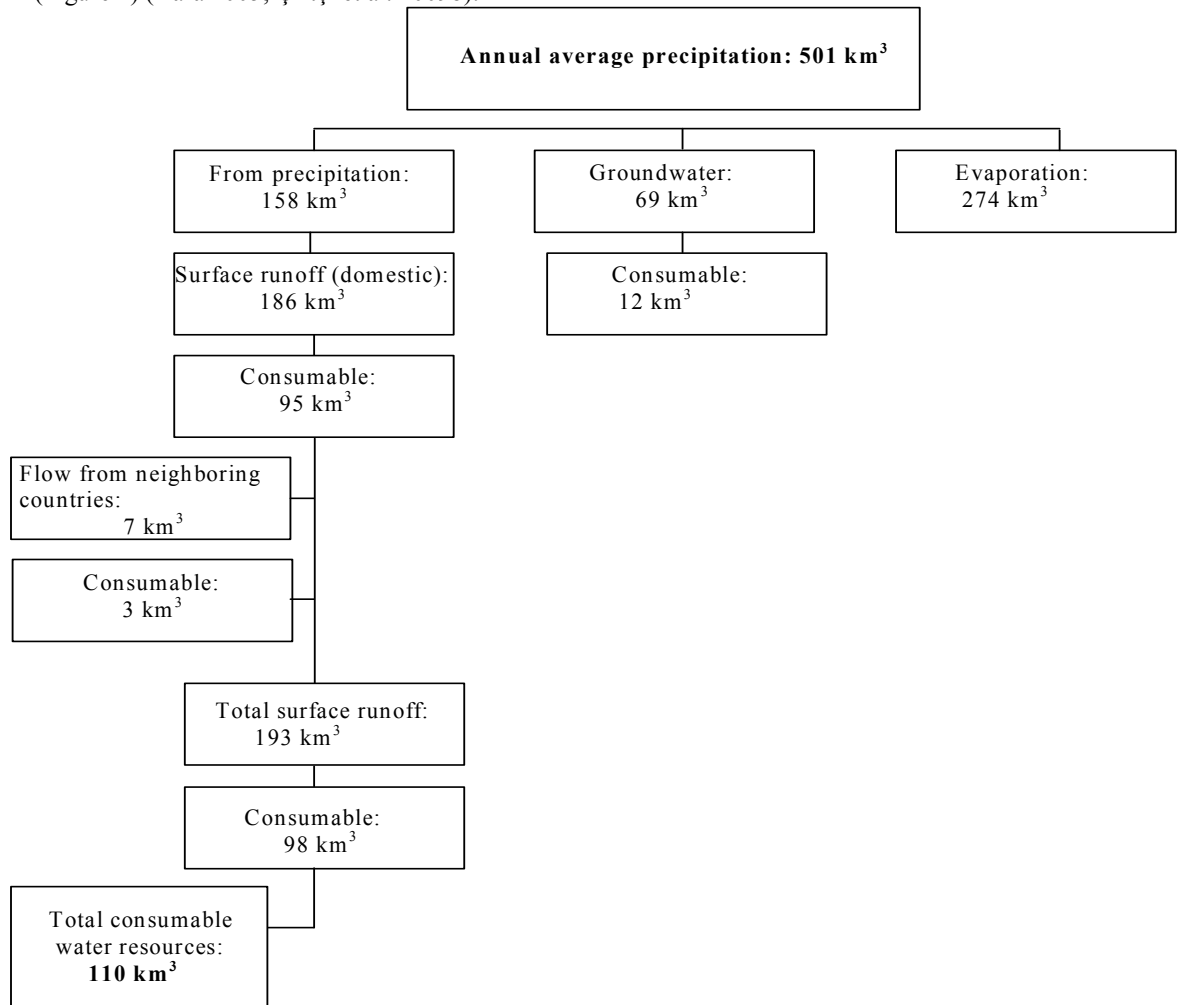


Figure 1. Water Potential of Turkey.

Water supply is used for different purposes such as energy production, irrigation, and others. By considering increase in population requirement to the water due to the irrigation, drinking and usages with demands to water in developed industry and tourism sector, water consumption estimation has been performed in Turkey.

The water consumption estimation performed by sector base, economically irrigable land potential of Turkey (8.5 million hectares) will be completely opened to the irrigation by construction of irrigation networks in the year of 2030 and also estimated that irrigation water uses will reach the 71.5 km³.

On the other hand, the main target is to minimize the water uses as 65% in total water uses by using the modern irrigation technologies in 2030. Thus, in sector base, all 110 km³ water will be used completely in 2030 (Table 2). Usages of fresh water potential and situation in the future are given in Figure 2 (Anonymous 2009).

Year	Total water use, km ³	Development, %	Water Use (km ³)					
			irrigation	%	Drinking-usage	%	industry	%
1999	35.645	34	26.415	75	5.520	15	3.710	11
2000	38.900	35	29.200	75	5.700	10	4.000	11
2001	39.300	36	29.300	75	5.800	15	4.200	10
2002	40.000	38	32.000	75	6.000	15	4.300	10
2030	110.000	100	71.500	65	25.300	23	13.200	12

Table 2. The Usage of Water in Sector Base in Turkey (Anonymous 2002)

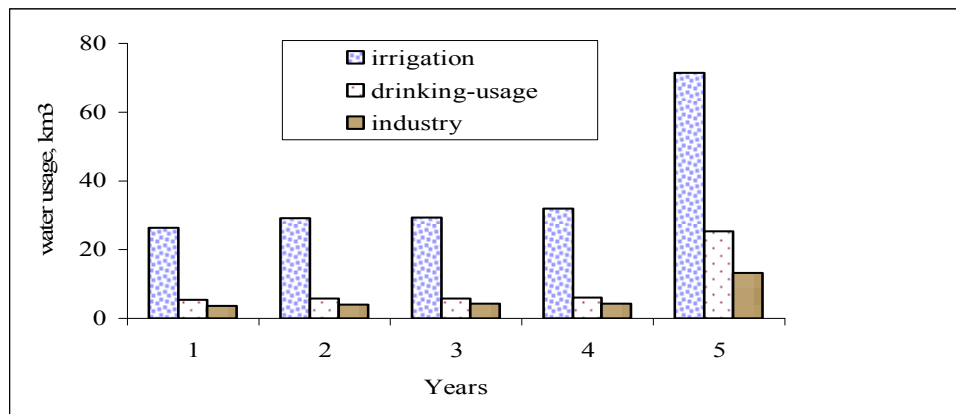


Figure 2. Water Usage Ratios in Turkey

Water-rich country can be defined as the country that has the water potential of 10 000 m³/person per year. According record of 2009, it is estimated that the population is about to the 72.5 millions in Turkey. The annual water potential per capita is 2565 m³.

The available water potential per capita is 1375 m³/person/year. Thus, Turkey can be considered a 'water-stressed' country by comparison to the some countries.

According to the Government Statistical Institute records, it is estimated that the population will reach about to the 80 millions in Turkey in the year of 2025 year. The available water potential per capita will reduce to the 1375 m³/person/year. It is possible to estimate the importance of water potential by considering some factors such as present growth rate and variations in water consumption habits. This estimation is valid under the conditions of transferring the present resources without any destruction up to 2025. Therefore, in order to transfer the water resources properly and sufficiently to the next generation, water resources should be conserved best and used efficiently.

Water Management and Sustainability Problems in Turkey

The residential and industrial water uses are getting increasing and there is a competition between these two sectors and agricultural use.

To improve the efficiency of irrigation, there is a need a irrigation method covered high crop yield, elements of modern irrigation technologies.

Water Management

Water management is defined as development , distribution and uses of water resources. Main goal in water management is improvement of the farmers income. This can be obtained by effective water distributions and uses. Water management is briefly described as the distribution and uses of water.

The number of organizations are responsible in water management at Turkey. Similar responsibilities may result conflict and problems in practice. However, there are two important organizations for water management namely General Directorate of State Hydraulic Works (GDSHW) and City Private Management (CPM) are two government organizations.

According to 2008 records, the area for opened to the irrigation is about 5.1 million hectares, and 2.9 million hectares and 1.3 million hectares have been irrigated by GDSHW and General Directorate of Rural Services and Public (GDRS), respectively. The rest 0.9 million hectare has opened to irrigation by farmers.

The 6.5 million hectors of the total 8.5 million economically irrigable land will be managed by GDSHW in 2030. The other 1.5 and 0.5 million hectare land will be irrigated by other government organizations and public sector (Anonymous 2009). There are different management types in Turkey. These are;

Government irrigation management: The first big government irrigation manager is a GDSHW and responsible for constructions of dams. These dams are not so much so that the organization has managed, maintenance-repair of such dams. Due to the not transfer of huge structures and difficulty in management those structures have only managed by GDSHW.

Management with local managers: In small places where the not availability of irrigation cooperatives and water user associations (WUA) or even making the organization but not properly managed small areas, municipal or local managers or community have managed the systems. In local management, poor management of irrigation structures and not having the sufficiently information and use the irrigation systems as financial sector are the deficiency of local management. The efficiency of this management is low.

Public Irrigation: Farmers are the manager in this system and is small or medium scale irrigation management. There is transfer problem in this management. Farmers solve their problem by using their facilities. They are responsible for them and effectiveness is parallel with the their experiences.

Irrigation Cooperatives- Water management: Irrigation cooperatives were built with 1163 number by cooperative policy. The components of cooperative are General Community, Management Community and Control Unit. In addition, Irrigation Cooperative Superior Community and Irrigation Cooperative Central Association are available (Çiftçi et al. 2008). The purposes of irrigation cooperatives are determined by negotiations and these are follows (Çiftçi 1991) ;

- These cooperatives may construction of irrigation structures for agricultural uses, management, maintenance-repair, land consolidation if necessary, supply credit in water obtaining points.
- The number of the irrigation cooperative was 2386 in 2006 in Turkey and members in cooperatives, number of the association and central association were 280043, 7 and 1, respectively (Anonymous 2006). The areas served by cooperatives (1307852 ha) are presented in Table 5.
- Irrigation cooperatives have appropriate management model for small-medium sized farms as well as farmers' self-government democratic management, ease of self-

regulatory and public administration by the control status and have the capacity of meeting maintenance and repair expenses. However, they have the some disadvantages such as members of farmers in cooperatives could not detect the purposes of these organizations, having financially, legally and technically inadequacy.

Water Use Associations (WUA) : WUA is built by local management permission and it has the government characteristics. Personal are employed like the government criteria. However, the members of the decision makers and managers are selected by farmers in WUA.

WUA can be built by required village and municipality. Each WUA has the special procedures. WUA community and community members are present in accordance of their procedures. The general secretary must be agriculture engineer and organizes works as if head of the WUA. The management of WUA is conducted by legislation, management and official decisions.

GDSHW has transferred 2.090.330 ha areas of total opened irrigation of 2.9 million ha according to the 2008. The 1.883.702 ha area has transferred to the 362 WUA. GDSHW has transferred 90% of opened irrigation to the WUA (Anonymous 2008).

Water Supply	Irrigated Land (ha)	%
Small Dam	143385	10.96
Surface	858837	65.67
Groundwater	30563	23.37
Total	1307852	100

Table 3. Areas Served by Cooperatives

In considering the total 5.1 million irrigated areas in Turkey, 37% of it has transferred to the WUA. There is some problems during transferring of irrigation Networks in Turkey. These are mostly legislation, financial and technical problems.

Problems in irrigation management

Development and management policies in soil and water resources should be rereviewed in Turkey. For sustainable irrigated agriculture, water management and management policies of government, irrigation cooperatives and WUA should be reviewed and required regulations should be performed. In recently, government is the exception for water management and it can be responsibilities of contributions to the water users and guide.

The purposes of transferring irrigation water management are follows:

- Facilitates farmers attendance and responsibility in management
- Local management in determined rules by farmers,
- Self inspection by own members,
- Reduction in management-maintenance and meeting the outcomes by farmer organizations.

Cooperatives are mostly ignored in irrigation water management. However, in small-scale production countries cooperatives are much more effective.

Organizations	Number	Ratios (%)	Area (ha)	Ratios (%)
WUA	362	42,7	1 883 702	90,1
Irrigation cooperative	100	11,8	94 148	4,5
Municipal	154	18,2	70 612	3,4
Village Community	225	26,5	40 198	1,9

Others	6	0,8	1 670	0,1
TOTAL	847	100	2 090 330	100

Table 4. Transferred Areas and Organizations (Anonymous 2008)

Water management has transferred to the Village Community, Municipal, WUA, Services performed helps to villages, Cooperatives and Universities. The top rank is WUA between these. Various problems may be observed in irrigation water management in Turkey. These are as follows;

- Deficiency in attendance of farmers to the irrigated agriculture investments and problems in re obtaining of charges,
- Deficiencies in water conveyance, distribution and applications and excess water losses,
- Postpone problems such as in land leveling, consolidation, electrification,
- Observation of some problems in reduced yield, salinity and drainage,
- Surface and groundwater contaminations via agricultural chemicals, food nutrients and industrial wastes,
- Low irrigation efficiency and irrigation ratios, excess water losses and low irrigation performance due to the surface irrigation methods,
- Incorrect crop patterns in region,
- Maintenance-repair problems in irrigation networks,
- Postpone in maintenance-repair works after the transfer or irrigation management to the WUA and irrigation cooperatives,
- Financial, legislation, management and education problems in irrigation cooperatives and WUA.

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